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Estimation of the J-curve effect in the bilateral trade of Hungary

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Abstract

Resulting in a J-curve pattern, the devaluation or depreciation of a currency worsens the trade balance before improving it. The aim of the paper is to investigate the J-curve effect in bilateral trade flows between Hungary and its major trading partners: Germany, Austria, Italy, France, the Netherlands, the United Kingdom, Poland and the Czech Republic. This paper explores the J-curve effect using quarterly data over the period 1997–2012. We include bilateral export and import flows, GDP and nominal bilateral exchange rates in the models. We employ a Johansen cointegration test to analyse the long run relationship between variables. The short run effects and related J-curve effect are explored by estimating an error correction model and by assessing impulse response functions. A typical J-curve effect is detected in bilateral trade flows with the United Kingdom. In trade flows with Austria and Italy, a partial J-curve can be observed. In bilateral trade with the Czech Republic, we explore an inverse J-curve. In other cases, the coefficient estimates follow any specific pattern.

Keywords

Exchange rate, Hungary, international trade, J-curve, trade balance, vector error correction model

JEL Classification: F10, F14, F31

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1. Introduction

Hungary's economic development is largely determined by the external conditions that affect the economy mostly through foreign trade. Hungary is a small open economy with one of the highest export to GDP ratios in the region. As IMF (2012) confirms, exports represent a high share of its GDP and have been the only source of growth since the crisis. A dominant share of industrial products, machinery and transport equipment and products, and pharmaceutical and chemical industries characterise Hungary's export structure. Additionally, the domestic market is insufficiently large to support a vast scale of production and inevitably depends on imports from other countries to supply a part of domestic consumption. Hungary imports mostly machinery, equipment, other manufactured goods and fuels and electricity (KSH, 2013).

This fact makes Hungary's economy more vulnerable to any adverse changes in other economies (especially the economies of trading partners) and raises a need for more intensive cooperation with foreign countries. Both exports and imports are affected by exchange rates and their regimes and development. According to Abeysinghe and Yeak (1998), policy prescriptions have generally assumed that exchange rate depreciation stimulates exports and curtails imports, while exchange rate appreciation is detrimental to exports and encourages imports.

The deterioration of the U.S. trade balance in 1972 despite the devaluation of the dollar in 1971 resulted in a body of literature in which authors distinguish the short run effects of currency depreciation from the long run effects (Bahmani-Oskooee and Kantipong, 2001). The short run and long run relationships between exchange rates and international trade have been subject to many empirical studies.

One can find some support in the theory for the pattern known as the J-curve phenomenon. Currency depreciation is said to improve the trade balance only from the long run perspective; in the short run, it rather worsens the trade balance than improving it (Magee, 1973). There are numerous empirical studies exploring this issue, but their findings are mixed and they depend on the region and period under estimation as well as data and methodology used.

The aim of this paper is to explore whether exchange rate depreciation improves bilateral trade balances between Hungary and Austria, the Czech Republic, France, Germany, Italy, the Netherlands, Poland and the United Kingdom. The data used in this study cover the period from 1997 to 2012. For this purpose, we employ a Johansen cointegration test to analyse the long run relationship between variables. Short run effects and the related J-curve effect are also explored by estimating an error correction model and by assessing impulse response functions.

Hence, this study provides additional evidence on the effect of exchange rate development on trade flows in the context of an emerging market after the most turbulent part of economic transformation. One aspect of this transformation was the change in the exchange rate arrangement as a transition from pegging the forint against a basket of currencies to a free-floating currency. Other important elements were the market reforms to price and trade liberation. In addition, Hungary is an interesting objective to study the J-curve effect because foreign trade represents a significant channel of economic integration within Central European countries or the EU as a whole. International trade usually has a tendency to be a driver of neighbouring countries' economies with open trade regimes and high foreign direct investment (FDI) (Auboin and Ruta, 2012). This fact can be illustrated by the increasing share of merchandise trade relative to Hungary's GDP. In 2011, it was 152.9% compared with 86.7% in 1997.

This paper continues as follows: in the next section, the theoretical framework and previous research are reviewed and reported; the third section focuses on the model specification and data description; in the fourth section, the presence of the J-curve phenomenon is explored and the last section concludes the paper.

2. Theoretical Framework and Literature Review

The theoretical basis of the J-curve comes from the Marshall–Lerner condition. This condition states that the sum of export and import demand elasticity has to be at least one and then currency depreciation will have a positive impact on the trade balance (Auboin and Ruta, 2012).

Changes in the exchange rate have two basic effects on the trade balance. Price and volume effects can be observed. Domestic currency depreciation (devaluation in fixed currency regimes) increases the price of imports in domestic currency terms, which means more expensive imports. Simultaneously, it decreases the price of exports in foreign currency terms; in other words, exports become cheaper. Given the above, the price effect of currency depreciation can increase the volume of exports and decrease the volume of imports (Gupta-Kapoor and Ramakrishnan, 1999).

If the volume effect is higher than the price one, the Marshall–Lerner condition is met. Usually, the Marshall–Lerner condition is not met in the short run; goods tend to be inelastic and depreciation deteriorates the trade balance initially. In the long run, consumers can adjust to the new prices; hence, the volume effect is generally believed to dominate the price effect and the trade balance will improve. The short run effect of currency depreciation and the related J-curve phenomenon was first advanced by Magee (1973). He points out that the short run deterioration and long run improvement in the trade balance after depreciation resemble the letter "J", as can be seen in Figure 1.

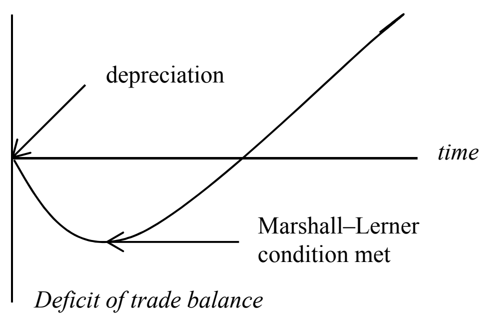

Figure 1 J-curve pattern
Source: Clarke and Kulkarni (2009)

Junz and Rhomberg (1973) attribute the J-curve phenomenon to five types of lags: in the recognition of exchange rate changes, in the decision to change real variables, in delivery time, in the replacement of inventories and materials and in production. Krueger (1983) explains the phenomenon by the fact that when an exchange rate change occurs, goods already in transit and under contract have been purchased and the completion of those transactions dominates the short-term change in the trade balance. Therefore, exchange rate change first deteriorates the trade balance, but as the elasticity of trading goods increases, it improves the trade balance.

Because this phenomenon is not always applicable in each country and not always consistent with the theoretical assumptions, the results differ across empirical studies. Despite numerous J-curve studies, few focus on Central European countries, including Hungary.

An extensive study of emerging Europe (Bulgaria, Croatia, Cyprus, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine) was carried out by Bahmani-Oskooee and Kutan (2009). They use monthly data over the period January 1990 and June 2005 and apply the conditional autoregressive distributed lag cointegration approach and corresponding error correction model. They find empirical support for the J-curve effect in Bulgaria, Croatia and Russia. In Hungary, however, they find no characteristics or signs of the existence of the J-curve effect.

Hsing (2009) examines the J-curve for bilateral trade between Croatia, the Czech Republic, Hungary, Poland, Slovakia, Slovenia and the US. This paper concludes that the J-curve is not empirically confirmed for any of these six countries.

Using generalised impulse response functions, Hacker and Hatemi (2004) test the J-curve for three transitional Central European countries (the Czech Republic, Hungary and Poland) in their bilateral trade with respect to Germany. Their findings suggest that some characteristics for Hungary are associated with a J-curve effect. After a real or nominal depreciation, the trade balance briefly drops to below its initial value within a few months and then rises to a long run equilibrium value higher than the initial one.

Trade balances in Central and Eastern European countries were studied also by Sequeira and Lopes (2010). They assess the existence of an S-curve pattern, which represents the relationship between the trade balance and terms of trade using cross correlation. The empirical results support the existence of this curve for Slovenia, the Czech Republic and Hungary.

Šimáková (2012a) investigates the J-curve pattern in bilateral export and import flows between Poland and its major trading partners using quarterly time series data over the period 1997:1 to 2011:4. This paper applies the Johansen cointegration test to analyse the long run relationship. The short-term effects and related J-curve effect were explored by estimating the error correction model and assessing the impulse response function. The paper shows that the depreciation of the zloty is accompanied by a deterioration of Poland's trade balance with France and Italy. Further, a partial J-curve effect can be observed in the case of Poland's trade flows with Germany and the Czech Republic.

By applying the same approach, Šimáková (2012b) analyses the impact of exchange rates on bilateral trade flows between Slovakia and its seven major trading partners including Hungary. This paper investigates the J-curve phenomenon using quarterly time series data over the period 1997:1 to 2010:4 and shows this phenomenon in the case of Hungary as well as a partial J-curve for France and an S-curve for Austria.

The most recent study by Nusair (2013) tests the J-curve phenomenon for 17 transition economies using monthly data over the period 1991–2012. He uses, for this purpose, the conditional autoregressive distributed lag bounds cointegration approach and error correction modelling as well as aggregated data and real effective exchange rates. The results suggest evidence of the J-curve phenomenon for Armenia, Georgia and Ukraine, but not for Hungary.

In summary, the existing empirical literature on the J-curve phenomenon concerning Central European countries is very limited and shows no clear conclusions in terms of the relationship between exchange rates and the trade balance. The results of the few previously published studies indicate almost no evidence of the J-curve effect. Therefore, this study substantially contributes to scientific discussion in this field and bridges the gap in the literature.

Compared with other papers, we use the most recently available data on foreign trade with the largest partners. As Rose and Yellen (1989) argue, when estimating the trade balance model using aggregate data, one needs to construct a proxy for world income and constructs can be partly misleading. Therefore, in this paper we employ bilateral exchange rates and bilateral trade balance data. We distinguish invoicing currencies where applicable, and we employ the Johansen cointegration approach and corresponding error correction modelling with impulse response functions.

3. Model Specification

The consensus among all recent studies is that the bilateral trade balance should depend on domestic income, the income of a trading partner and bilateral exchange rates. We use the cointegration procedure developed by Johansen (1997) in order to detect the long-term comovement among the variables. This avoids the main criticism of early studies, whose results could suffer from regression problems because of non-stationary data. Thus, following Bahmani-Oskooee and Kutan (2009), equation (1) is adopted in the empirical modelling of the J-curve effect:

$$ln\,TB_t = \alpha + \beta\, ln\,Y_{d,t} + \gamma\, ln Y_{f,t} + \lambda\, ln\,ER_t + \varepsilon_t, \qquad (1)$$

where TB is a measure of the trade balance in time period t defined as the ratio of the exports of Hungary to country f to Hungary's imports from country f. The trade balance is measured as the ratio rather than the difference between exports and imports. Bahmani-Oskooee (1991) argues that this measure is not sensitive to the units of measurement and reflects the movement in the trade balance in real or nominal terms. Hence, the model could be expressed in log-linear form.

Following Bahmani-Oskooee (1991), Y_d is the measure of Hungary's income set in index form to make it unit free and Y_f is the index of the real income of trading partner f. The income of countries is represented by their GDP. Therefore, the estimates of β and γ could be positive or negative. An increase in domestic income usually leads to higher imports, which means a negative estimate for β. However, if the increase in domestic income is due to an increase in the production of import-substitute goods, imports could actually decline, which means a positive β (Bahmani-Oskooee, 1986). According to this, the estimate of γ is supposed to be positive, because an increase in foreign income usually leads to higher exports, as this represents increased demand for Hungary's trading goods and therefore means a positive estimate of γ.

ER is the nominal bilateral exchange rate between the forint and the currency of trading partner f. The nominal exchange rate is chosen, as nominal and real exchange rates tend to move closely together and the choice is not likely to affect the econometric results (Auboin and Ruta, 2012).

The above-defined trade balance model represents the long run relationships between the trade balance and its determinants. To test the J-curve phenomenon in the short run, short-term dynamics must be incorporated into the long run model. According to Hsing (2009), we apply for this purpose the following modified error correction model:

$$\begin{aligned}\Delta\, ln\,TB_t = \alpha + \sum_{i=1}^{n} \omega_i \Delta\, ln\,TB_{t-i} + \sum_{i=1}^{n} \beta_i \Delta\, ln\,Y_{d,t-i} + \\ + \sum_{i=1}^{n} \gamma_i \Delta\, ln\,Y_{f,t-i} + \sum_{i=1}^{n} \lambda_i \Delta\, ln\,ER_{t-i} + \upsilon_i EC_{t-1} + \varepsilon_t,\end{aligned} \qquad (2)$$

where additional to equation (1), υ is the speed of parameter adjustment and EC represents the residuals obtained from the estimated cointegration model of equation (1).

4. Empirical Results

This section reports the estimates of the J-curve for Hungary and its eight major trading partners: Germany, Austria, Italy, France, the Netherlands, the United Kingdom, Poland and the Czech Republic. The vector error correction model (2) is estimated by using quarterly data over the period 1997: 1 to 2012: 2. All data are obtained from the OECD iLibrary statistical database. The data are in current prices and denominated in United States dollars (USD), and they refer to declared transaction values. Imports are reported c.i.f. and exports are reported f.o.b. with the exception of the Slovak Republic where imports are reported f.o.b. Quarterly data are calculated as averages of monthly figures.

The selection of countries is based on the share of Hungary's total international trade turnover. Average shares of selected trading partners for the entire sample period are reported in Table 1.

Table 1 Average shares in international trade of Hungary (1997–2012, in %)

Trading partner	Share on total imports	Share on total exports	Share on total trade turnover
Austria	5.98	8.2	7.04
Czech Rep.	2.51	2.96	2.72
France	4.82	4.56	4.68
Germany	28.01	28.13	28.03
Italy	5.23	6.32	5.79
Netherlands	3.09	3.75	3.42
Poland	2.94	3.41	3.18
UK	4.22	2.56	3.39

Source: Authors' calculation based on data obtained from OECD iLibrary.

Before conducting the necessary tests and empirical estimations, the time series used in the analysis are adjusted by using a logarithmic transformation. This helps reduce skewness and heteroscedasticity and stabilise variability. The stability of regressors is needed in initial testing. Before the estimation of the cointegration parameters, the order of integration for each time series should be examined. According to Balke and Fomby (1997), non-stationarity on levels is the basic precondition of cointegration between variables. Integration is determined by using the augmented Dickey–Fuller (ADF) test recommended by Engle and Granger (1987). The ADF test for each individual time series confirms the presence of unit roots, i.e. first-difference stationarity is found for all variables. By performing additional Dickey–Fuller GLS and Phillips–Perron tests, we confirm our hypotheses about unit roots for all variables except the GDP of Italy. The results of the ADF test can be seen in Table 2, while the other results are available from the author upon request.

Since the choice of the lag orders of the variables in the vector error correction model specification can have a significant effect on the inference drawn from the model, another step of the analysis is to sequentially determine the appropriate lag length for each variable by using the Akaike Information Criterion and Schwarz Bayesian Criterion. In general, there is no agreement on which criterion is better, but in the case of different results for optimal lag, we prefer the Schwarz Bayesian criterion, which is more consistent.

Table 2 ADF tests at the 5% level of significance

Variable	Test statistics on level	Critical values on level	Test statistics on 1st d	Critical values on 1st d
lnY				
Hungary	–2.868	–2.910	–6.608	–2.911
Austria	–0.825	–2.914	–3.689	–2.915
Czech Rep.	–2.231	–2.910	–3.039	–2.912
France	–1.622	–2.910	–3.732	–2.910
Germany	–0.226	–2.910	–5.170	–2.910
Italy	–2.870	–2.912	–4.119	–2.910
Netherlands	–2.864	–2.910	–4.367	–2.910
Poland	–1.454	–2.911	–5.287	–2.910
UK	–1.785	–2.910	–4.859	–2.910
lnTB				
Austria	–2.039	–2.909	–9.716	–2.910
Czech Rep.	–2.231	–2.909	–9.334	–2.910
France	–2.375	–2.915	–4.239	–2.914
Germany	–2.037	–2.910	–9.807	–2.910
Italy	–1.078	–2.910	–11.437	–2.910
Netherlands	–1.754	–2.909	–8.095	–2.910
Poland	–1.947	–2.910	–8.774	–2.911
UK	–1.244	–2.908	–9.711	–2.909
lnER				
HUF/EUR	–2.904	–2.911	–6.905	–2.911
HUF/PLN	–1.882	–2.909	–6.513	–2.910
HUF/CZK	–1.328	–2.911	–6.317	–2.912
HUF/GBP	–2.315	–2.914	–5.671	–2.910

The number of lags can differ across trading partners due to the structure and elasticity of trading goods and time lags in the consumer's search for acceptable, cheaper alternatives (Auboin and Ruta, 2012). Once the optimal lag order has been determined, we can perform cointegration analysis and test the existence of a stable long run equilibrium between the non-stationary variables. The results of the optimal lags are stated in Table 3.

If the variables are found to cointegrate (parameters are stable), the final step in the analysis is the estimation of the vector error correction model to generate the impulse response functions and construct the J-curves. We proceed to examine the dynamic responses by generating impulse response functions showing the response of the trade balance to the forint depreciation. As indicated before, the short run effects of depreciation are reflected in the coefficient estimates obtained for the lagged value of the first-differenced exchange rate variable. The J-curve phenomenon should be supported by negative coefficients followed by positive ones, as reflected by the shape of the estimated J-curves. The specific results of the estimations of the vector error correction models are available from the author upon request.

Table 3 Optimal lags in cointegrated time series

Trading partner	Optimal lags
Austria	2
Czech Rep.CZK	1
Czech Rep.EUR	2
France	4
Germany	3
Italy	3
Netherlands	2
Poland PLN	1
Poland EUR	2
UK GBP	1
UK EUR	2

The graphical representations of the impulse response functions for the trade flows between Austria and Hungary do not present a typical J-curve. As can be seen in Figure 2, the exchange rate change first deteriorates the trade balance and then improves it, but just for one quarter.

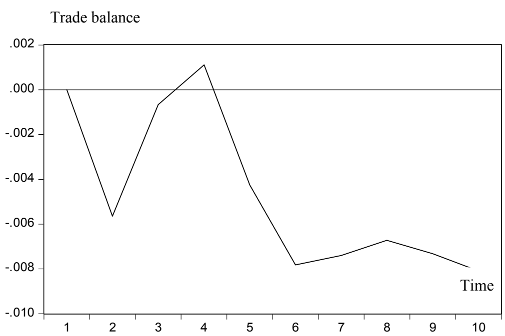

Figure 2 Bilateral J-curve with Austria

For the Czech Republic, two J-curves based on the invoicing currency are constructed. Euro means another invoicing currency, as it is used as a natural hedging instrument or universal currency for the foreign trade of companies. In both cases, we can observe the initial inverse J-curve behaviour of the trade balance. As can be seen in Figure 3, for trade flows in the Czech koruna, this effect persists, but after three quarters is lower. Per contra, for the J-curve constructed in the euro invoicing currency, after three quarters we found a deterioration under the initial value (see Figure 4).

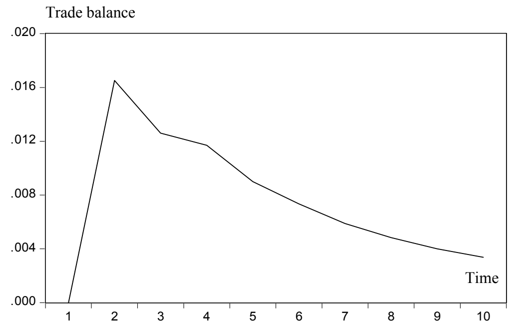

Figure 3 Bilateral J-curve with CR in CZK

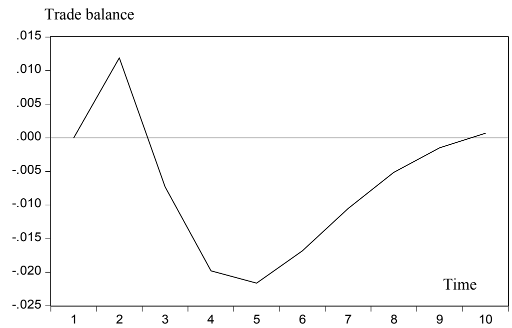

Figure 4 Bilateral J-curve with CR in EUR

The graphical representations in Figures 5–7 do not present typical J-curves. The depreciation of the Hungarian forint is accompanied by the deterioration of Hungary's bilateral trade balance with France, Germany and the Netherlands. It can be stated that the Marshall–Lerner condition is not met and that the price effect of currency depreciation does not increase the volume of exports or decrease the volume of imports to the needed value. In the case of Germany, the results are similar to those of Hacker and Hatemi (2004).

For Hungary's trade flows with Italy, a just partial bilateral J-curve effect can be observed in Figure 8. The theoretical J-curve pattern is detected in the first three quarters. After this period, the bilateral trade balance declines to below its initial value within a few months.

Given the example of the Czech Republic, we distinguish Hungary's trade with Poland into trade denominated in the euro and trade in the Polish zloty. As is evident from Figures 9 and 10, there is a significant difference and, hence, the effect of depreciation is strongly dependent on the invoicing currency. The respective impulse response function for euro terms shows an initial improvement during the first two quarters followed by a deterioration of the bilateral trade balance. On the contrary, one can find some features of the J-curve effect in the response of the

Figure 5 Bilateral J-curve with France

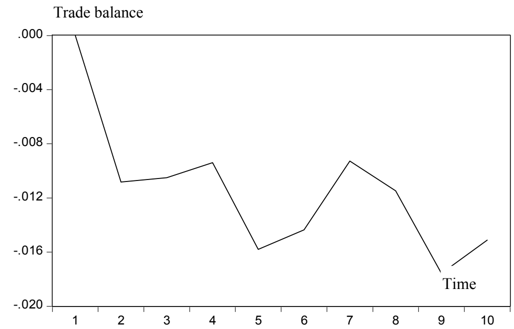

Figure 6 Bilateral J-curve with Germany

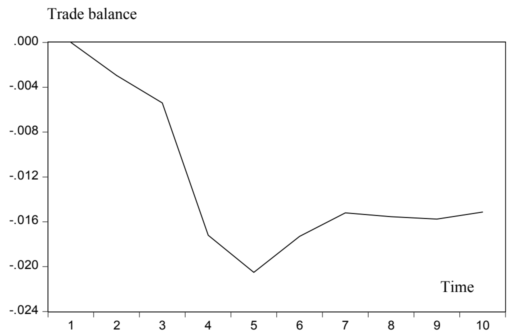

Figure 7 Bilateral J-curve with Netherlands

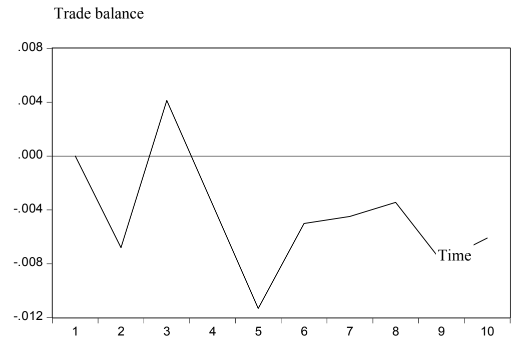

Figure 8 Bilateral J-curve with Italy

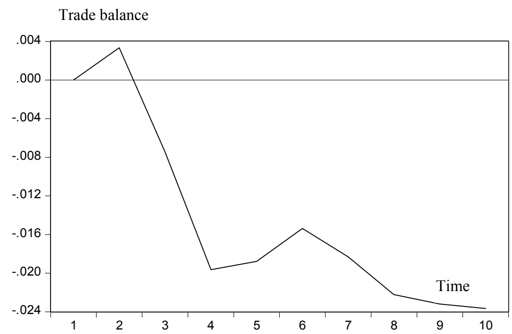

Figure 9 Bilateral J-curve with Poland in EUR

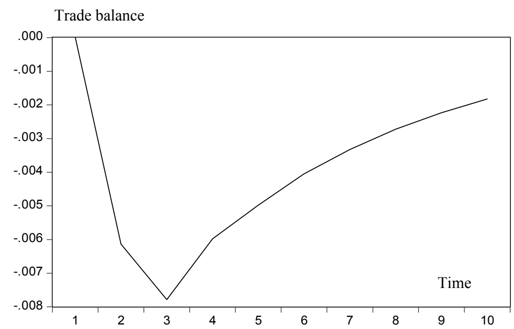

Figure 10 Bilateral J-curve with Poland in PLN

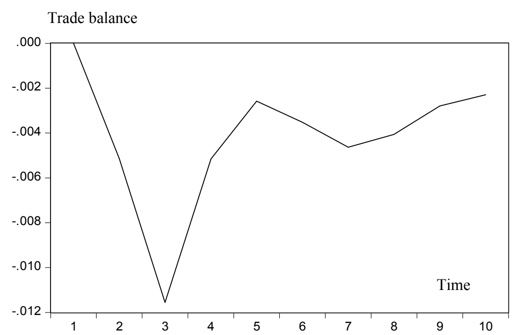

Figure 11 Bilateral J-curve with UK in EUR

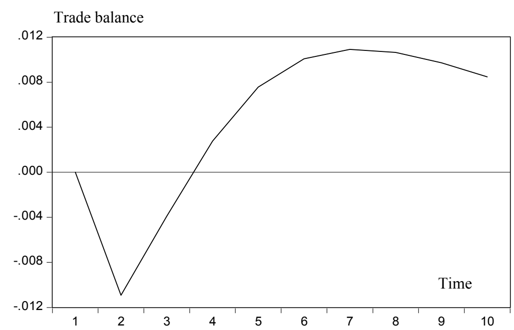

Figure 12 Bilateral J-curve with UK in GBP

trade balance after the impulse of the depreciation of the Hungarian forint to the Polish zloty.

The only typical J-curve effect is shown for bilateral trade flows with the United Kingdom realised in British pounds (see Figure 12). For the euro invoicing currency, in the same case, we observe a partial J-curve effect in Figure 11.

Therefore, the results indicate that an active exchange rate policy that aims to influence exchange rate development is not supposed to promote any notable improvement in the trade balance. Thus, the development of Hungary's international trade seems to be affected by other factors than changes in exchange rates.

According to Mandel and Tomšík (2006), FDI can affect the trade balance through the positive impact on real exports and by reducing the imports of final products. Additionally, FDI in the industrial sector usually needs to import inputs, which increases the total volume of imports and makes the import intensity of Hungary's exports very high. The next important factor in the determination of the trade balance is the structure and demand elasticity of traded goods. The negligible impact of exchange rates on the trade balance can also be explained by the increasing volume of hedging instruments used in Hungary to manage exchange rate risk (Dömötör and Havran, 2011). Another important factor influencing the results may be the effect of the branding corrective item and related changes in national external trade statistics. According to CNB (2011), branding as a phenomenon of economic globalisation has been identified in various EU countries, including Hungary.

In the comparison of the major common trading partners of Central European countries by Šimáková (2012a, 2012b), we can see few common responses of trade balances after currency depreciation. Research for Slovakia has similar findings for trade with Austria and France. In the case of Poland, we can observe similar results for trading with Italy, Germany and France. In all these trade flows, the euro is used as the invoicing currency. It is not confirmed in the case of the United Kingdom, where the euro is only an additional invoicing currency.

5. Conclusion

The aim of the paper was to investigate the impact of exchange rate changes on bilateral export and import flows between Hungary and its major trading partners. We included the eight largest trading partners in the analysis. We employed a Johansen cointegration test to analyse the long run relationship between variables. The short run effects and related J-curve effect were explored by estimating an error correction model and by assessing impulse response functions. The results suggest that the effect of depreciation of the Hungarian forint is usually weak and that its direction differs by country.

We showed that the depreciation of the local currency accompanied by the short run deterioration and the long run improvement of the trade balance only occurs in trade flows with the United Kingdom. A partial J-curve effect can be observed in the case of Hungary's trade flows with Austria and Italy. By contrast, an inverse J-curve was uncovered for trade between Hungary and the Czech Republic. In other cases, the coefficient estimates follow any specific pattern, but the depreciation of the Hungarian forint causes the deterioration of bilateral trade balances.

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